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ABSTRACT

The purpose of this study was to design a test that could be used to detect differences in environmental attitudes. A semantic differential instrument, using projected color slides to represent environmental concepts, was developed and its reliability determined. Pilot tests run with two different groups of students are reported. On the basis of the reliability procedures and the two pilot studies, it is proposed that the instrument is a valid, reliable, and sensitive indicator of environmental attitudes. (DT)

THE DESIGN OF A MODIFIED SEMANTIC DIFFERENTIAL INSTRUMENT FOR DETERMINATION OF CHANGES IN ENVIRONMENTAL ATTITUDES

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INTRODUCTION - ENVIRONMENTAL ATTITUDE RESEARCH

In response to public awareness and increased concern over environmental pollution, a number of ecology related curriculum have been produced within recent years. Generally these courses of study are affectively orientated and have the primary objective of increasing student awareness and forming positive attitudes toward environmental conservation.

The need for changing attitudes as a prerequisite for controlling pollution has been noted. Stebbins (1971), in outling the relationship between attitude and the willingness to act towards correcting environmental problems, stated:

> ...the solution lies rather in changing social attitudes, which is far more difficult than developing new techniques. It seems clear that until we can achieve a widespread change in our attitude toward nature, the degradation of our biosphere will continue (p. 168).

To attain the affective goals of environmental education there is a need for the evaluation of existing student attitudes. Only with the ability to measure attitudes and detect attitude changes can the effectiveness of specific environmental curriculum and methods be adequately analyzed. In addition, attitudes of students must be surveyed to obtain maximum correlation between curricular materials course concepts and student maturity levels. As stated by Mortensen (1972):

> ...with a fuller understanding of student attitude, educators will be in a better position to design curricula intelligently which will not only provide knowledge, but will build on mature attitudes which are in accordance with a rational and common desire for a more sanitary environment (p. 23).

The majority of environmental attitude research has been conducted within recent years and has focused on the secondary student. Mortensen (1972), Swan (1969), Marlett (1972), Eaton (1971) and Snyder (1972) have attempted, through a variety of instruments, to survey environmental attitudes and identify factors which affect them.

Burchett (1971) devised an instrument to measure environmental attitude in elementary school children. A model to evaluate the effectiveness of a K-12 environmental education curriculum has been designed by Bennett (1972) but was restricted in test application.

PURPOSE

The purpose of this study was to design a test instrument that could be used to detect differences in environment attitude. The rationale for the study, as previously stated by Mortensen (1972), is recapitulated by Snyder (1972):

> ...the appraisal of student knowledge, attitude, and practices is indispensable. Such evaluation is necessary if organized instructional endeavors are to improve in something more than a haphazard fashion (p. 2).

It was hoped that implementation of such measurement techniques would be of use in the design of environmental science curricula to best compliment student attitudes.

THE INSTRUMENT

On the basis of existing environmental attitude research it was decided to design a semantic differential instrument. Mortensen (1972), Eaton (1971), and Burchett (1971) incorporated the use of the semantic differential method for measuring environmental attitudes. However, a basic alternation in the method as presented by Osgood (1957) was used. The modification was the mode of presentation of concept stimuli. In place of the written word, projected 2x2 color slides were used to represent environmental concepts. As stated by Campbell (1950), an instrument must "not destroy the natural form of the attitude in the process of describing it (p. 15)." As the environment is a constant perceptual experience, to determine attitude towards it, a realistic pictorial representation is a more valid stimulus than the symbol of the written word.

The use of pictures as concept stimuli for semantic differential scales is a recent innovation in attitude research. In a presentation at the 1973 National Science Teachers' Convention, Leith (1973) supported the use of slides to measure attitude changes in an elementary school environmental science program. Shafer and Richards (1971) have also used slides as concept stimuli for semantic differential scales. On comparing the pictorial versus verbal modes of stimuli presentation Shafer and Richards (1971) concluded:

> Color slides that adequately portray the variation of an outdoor environment may be adequate for measuring semantic differential responses about that scene...they agree favorably with similarily measured on-site responses to the same scene (p. 26).

Osgood (1957), in summarizing a study of the meaning of political cartoons, supported the validity of pictorial representation of objects as being signs for those objects:

> ...These results support the conclusion that for certain pictorial symbols, at least the meaning of the symbol may be shifted completely to that of the thing symbolized...ordinary pictorial signs are semantically equivalent to linquistic signs. (p. 299)

DEVELOPMENT OF THE INSTRUMENT

Ninty-six chemistry students from East Syracuse-Minoa High School, East Syracuse, New York were chosen to partake in the selection of word pairs and concepts for use with the test instrument. These students had previously been exposed to an ecology unit. Each student was given an envelope which contained fifty sets of bi-polar adjective word pairs obtained from various semantic differential tests (Osgood, 1957; Gross, 1971; Czirr, 1970; Gallagher, 1968) and from Roget's Thesarus. Each student was told to choose the fifteen word pairs which best fit his meaning to the words "environmental science". Word pairs chosen with a frequency over fifty percent were to constitute a pair for the test instrument. On this basis, sixteen word pairs were obtained, and then randomized as to their position on the test; vertically

to eliminate an increasing or decreasing order of strength and horizontally to eliminate all "positive" or "negative" words from being located in one column.

The same students were then individually exposed to thirty-five slides which were positioned on a slide sorter. The slides had been chosen from approximately 1600 slides to represent seven main concept areas of ecology and pollution. As with the word pairs, these slides were chosed by the authors and three other science teachers to establish face validity. Each student was instructed to choose the twelve slides that had the most meaning to the words "environmental science". The relative position of the slides were rearranged on the sorter after every five trials. Slides with the highest selection frequency in each of the seven groups would compose the tests concepts. These slides were then randomized as to their ordinal position for test presentation.

To measure reliability, the following two procedures were then carried out:

(1) After a three week interval a second identical selection process was undertaken using the same 11th grade students. The word pairs and slides were ranked in order of selection frequency and Spearman Rank Order correlations performed on the data from the two trails. Correlations of .92 for the word pairs and .93 for the test slides were determined.

(2) To determine the test retest reliability, the instrument was administered twice to 23 fourth, 16 eighth, and 21 twelth grade students. Raw score means for the sixteen word pairs for each of the seven concepts were correlated for each grade level. Correlations for the seven concepts are displayed in Table 1.

TABLE 1

TEST-RETEST CORRELATIONS

Concept	GRADE		
	4	8	12
1.	.9655	.9806	.9226
2.	.9634	.9770	.9789
3.	.7990	.6550	.9461
4.	.9677	.9795	.9717
5.	.6555	.9284	.9745
6.	.9680	.9671	.9615
7.	.9800	.9839	.9816

ANALYSIS OF TEST

The test is administered in a manner similar to the standard semantic differential instrument. The bi-polar adjectives were reproduced on test sheets with five scales between each word pair. Each subject receives seven sets of scales, one sheet per slide. Pictures are projected, one at a time allowing subject approximately 45 seconds between slides to respond to the sixteen word pairs.

Each slide (concept) is analyzed separately. Means, standard deviations and intercorrelations for each of the sixteen word pairs are calculated first. Then eigenroots and vectors are extracted from the 16 x 16 intercorrelation matrix. An eigenvalue equal to or greater than 1.00 is used as a cutoff point for the development of a factor-loading matrix in principal axis analysis.

The factor-loading matrix is then subjected to a Varimax rotation routine. Each possible pair of factor vectors is rotated to maximize the column variance until a complete pass through all combinations does not result in rotations of more than one degree. A Varimax factor score matrix is then generated by multiplying the factor-loading matrix by the matrix used to rotate the principal axis factor loadings.

A new data card is then punched for each subject. It contains an identification code and a subject related score (component score) for each varimax factor. The component score is generated by multiplying the standardized original response. For each of the 16 word pairs by the corresponding varimax factor and summing the result. An individual has one component score for each varimax factor.

The subject component scores are then subjects to analysis of covariance or analysis of variance depending on whether or not a measurement of change in attitude is sought.

PILOT TESTS

To determine the sensitivity of the instrument to attitude differences and changes both within and between various grade levels the following two tests were conducted:

(1) All the students enrolled in the N.Y.S. Regents Biology course (195) from a suburban school district took part in the research project. The total group was given the test and then the experimental group (N=68) were taught a two month unit dealing with environmental science. At the end of the unit all students took the semantic differential test again.

Analysis of the data isolated twenty-two factors related to the seven concept slides. Three of the factors indicated significant differences at the .01 level after two way analysis of covariance. All three of the significant factors were heavily weighted by adjective pairs related to interest and awareness.

(2) From the results of Pilot Test 1, it was shown that the test instrument was sensitive to changes in attitudes due to the affect of an independent variable. It was also decided to determine the sensitivity of the instrument to attitude difference among grade levels. Eight males and eight females from each of the grade levels 4, 6, 8, 10, 12 were chosen for study. As this study was a cross-sectional survey study, rather then a pre-post design, the mean component scores of the cells were subjected to analysis of variance procedures.

For all concepts except concept 5, five factors were generated from the factor analysis of the combined data. From observation of the adjective components, these factors appeared to be logical descriptions of environmental attitude. In addition the factors for each concept accounted for at least 60% of the common factor variance.

F test results from the two-way analysis of variance computations performed on each factor for the seven concepts indicated that significant differences among the grade levels existed ($\alpha = .05$). Also, differences in environmental attitude were found to exist between sexes for some of the factors generated ($\alpha = .05$). In total, 18 of the 35 factors were found to contain significant differences.

SUMMARY

The primary purpose of this research was to design a modified semantic differenctial instrument which is a reliable method for detecting differences in environmental attitudes. It was proposed that such an instrument could be used to survey existing environmental attitudes for purposes of curriculum development. By identifying attitude differences between and within grades, environmental curriculum could be introduced to best achieve intended cognitive and affective objectives. Also, once

existing attitudes have been identified, changes in those attitudes, due to such independent variables as teaching methods and/or materials could be analyzed.

On the basis of the reliability procedures and the two pilot studies conducted, it is proposed that the instrument developed is a valid, reliable, and sensitive indicator of environmental attitude and can be successfully used for the purposes outlined.

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